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Research Note

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COLD HARDINESS OF WESTERN LARCH POPULATIONS

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ABSTRACT

Cold hardiness of 1-year old seedlings representing 78 populations of Larix occidentalis *was studied. No differences could be detected among populations in tolerance to cold before frost in early September.*

KEYWORDS: Cold hardiness, cold acclimation, ecological genetics

Levels of cold tolerance differentiate populations of numerous forest trees: *Liquidambar styraciflua* (Williams and McMillan 1971), *Quercus rubra* (Flint 1972), *Abies grandis* (Larsen 1978b), and *Pseudotsuga menziesii* (Larsen 1978a; Campbell and Sorensen 1973; Rehfeldt 1977, 1978). In fact, populations of *Pseudotsuga menziesii* are so well differentiated that variation in hardiness has been used to limit seed transfer for reforestation in northern Idaho (Rehfeldt 1979a,b) and western Montana (Rehfeldt 1980).

Objectives of the present research on western larch (*Larix occidentalis*) involved assessing variation in cold hardiness among populations and developing limits of seed transfer from patterns of variation.

MATERIALS AND METHODS

About 50 seedlings representing each of 78 populations of western larch were grown in plastic containers (150 cm^3) in a shadehouse at Moscow, Idaho. Populations represented the geographic and ecologic distribution of the species in Montana, Idaho, and northeast Washington. Each population was characterized by latitude, longitude, elevation, and habitat type.

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Long shoots were exposed to freezing treatments early in September of the first growing season. Freezing tests were conducted on a single date because differentiation of populations of *Pseudotsuga menziesii* were most pronounced after bud set but before frost (Rehfeldt 1979b), and because a single sampling date required a minimum number of seedlings.

Freezing tests were conducted according to the general procedures outlined by Levitt (1972). For each population, six sets of 10 shoots were cut, moistened, and packaged in plastic bags. Plastic bags were suspended in a freezing chamber equipped with two fans for providing circulation. One set of bags from each population was frozen at a rate of 5°C/h to one of six test temperatures between -11°C and -16°C. Shoots were removed from the freezer when remote temperature sensors indicated that internal air temperatures had reached desired levels. Shoots were thawed at 2°C for 24 h, and afterwards, plastic bags were placed on a shaded greenhouse bench for 2 days. The proportion of shoots injured by freezing was recorded for each population at all test temperatures. Injury was scored by discoloration of wood tissues.

An analysis of variance was used to determine the extent of population differentiation. Regression techniques were used to relate patterns of differentiation to geographic and ecologic conditions of the seed sources.

RESULTS AND DISCUSSION

Whereas 88 percent of the shoots subjected to -16°C exhibited injury, only 15 percent were injured at -11°C. Damage to populations ranged from 18 to 87 percent. Yet, as shown by the following analysis of variance, differences among populations could not be detected statistically:

Source of variance	Degrees of freedom	Mean square	F-value
Treatments	5	50,268	54.39**
Populations	77	1,132	1.23
T x P	385	924	

**Statistical significance at the 1 percent level of probability.

The failure of statistical analyses to detect differences among populations is attributed to large effects of the interaction of populations with temperature treatments. Interaction was apparent in the original data: differences among populations simply were not consistent between temperature treatments.

Attempts were made to correlate population mean values with geographic and ecologic variables of the seed source: latitude, longitude, elevation, and habitat type. Simple correlations of the percent injury with the first three variables and regression analyses of injury on habitat types yielded only one statistically significant association. A weak positive correlation (r = 0.30, significant at the 1 percent level of probability) was observed between percent injury and latitude of the seed source. Because no other variables were related to mean injury, multivariate analyses were senseless.

The results imply that populations of western larch are not differentiated according to cold tolerance at a time when first frosts of autumn can be expected. But, the failure to detect differences could also result from experimental errors. Therefore, tests of cold hardiness in western larch should be repeated to either verify or refute present results.

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